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ABSTRACT

The purpose of this study was to ascertain (1) whether young children are able to recognize a need to check response accuracy and memory verification and (2) what strategies they use. A model of the nursery room was used to assess 37 preschoolers' recognition, recall, and spatial memory for school objects. Children were asked to verify their memories in order to determine verification strategies, and, following an opportunity to re-examine the criterion, memory was reassessed and performance compared to initial memory relative to these strategies. The results indicated that few children at first knew an objective way to verify but that after prompting most seemed aware of its utility. Although memory and verification scores were generally unrelated, spatial memory after verification was positively and significantly correlated with measures of verification. The memory verification paradigm introduced appears useful for studying purposeful behavior in young children. (Author/MP)

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Memory and Memory Verification
Capability of Young Children

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Footnote

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Abstract

A model of the nursery room was used to assess preschoolers' recognition, recall, and spatial memory for school objects. Children were asked to verify their memories in order to determine verification strategies, and, following an opportunity to re-examine the criterion, memory was reassessed and performance compared to initial memory relative to these strategies. The results indicated that few children at first knew an objective way to verify but that after prompting most seemed aware of its utility. Although memory and verification scores were generally unrelated, spatial memory after verification was positively and significantly correlated with measures of verification. The memory verification paradigm introduced appears useful for studying purposeful behavior in young children.

Memory and Memory Verification

Capability of Young Children

Although considerable significance has been attached to the notion of feedback in both theories of learning and developmental theory, little attention has been focused on the young child's awareness of the importance of feedback for self-monitoring performance, and by extension, development. Research tasks require of the child responses to be evaluated, but seldom is the child asked to assess the accuracy of his own performance. Perhaps this omission is due to a belief by some that the preschool child is egocentric and oblivious to any need to justify behavior.

The process of checking one's response with an external criterion is here referred to as verification. Verification involves an awareness that there is an objectifiable basis to one's knowledge and that proof is possible. Verification functions as supportive and corrective feedback involving the evaluative process of checking one's performance with an objective standard to test for discrepancies. Unlike predicting or explaining, which are essentially hypothesis-generating behaviors, verification can be described as hypothesis-testing behaviors. Verification is significant developmentally since it reflects decentration--the awareness if confirming one's perspective is possible. Little is known, however, of young children's understanding of verification and of the relation of verification with other cognitive abilities.

The purpose of this study is twofold: (1) to ascertain whether young children are able to recognize a need to check response accuracy, and (2) what strategies are used to verify? If the child seems to know how to verify, or to understand a method after it is suggested to him, we can ask a further question: Does performance on a memory task improve after an opportunity to reexamine the criterion? Subsequent memory performance in

relation to verification comprehension and behavior is examined in this study of evidence relating to the hypothesis that young children are capable of purposeful memory behavior.

Memory verification relates to the metamemory literature (i.e. Brown, 1975; Flavell and Wellman, 1977). However, verification of a memory is different from memory storage or memory retrieval as ways to study purposeful memory behavior. Purposeful storage behavior is usually inferred from memory performance following instructions to remember (Ryan et al., 1970). Purposeful retrieval behavior is studied by examining memory performance after providing some opportunity for using retrieval cues (Ritter, et al, 1973). The memory verification paradigm, on the other hand, first asks the child to make a response from general memory, and then asks the child to verify the response. Memory is reassessed and performance is compared to verification relative to initial memory performance.

The significance of this study rests on the fact that previous research of young children as deliberate rememberers has relied for the most part on assessment procedures that focus on the recall of events or recall predictions with no determination of the child's own verification of the accuracy of his memory or predictions. Moreover, past studies in most cases have used artificial assessment methods involving line drawing of printed word stimuli (e.g. Wellman, 1978) and not naturalistic methods. This study used familiar task content involving objects and the child's own nursery school.

Method

Subjects - The subjects were 37 middle class children (19 boys and 18 girls) with a mean age of 4 years and 7 months with a S.D. = 6 months. All children attended the same nursery school either in the morning (19 children with a mean age = 56 months) or in the afternoon (18 children with a mean age = 53 months) session. Testing began in the fourth month of the school year, after the children had an opportunity to become accustomed to their preschool environment.

Materials - A small scale model of the child's school room was used with miniature classroom objects as landmarks (Fig. 1). The model consisted of a 18" x 36" cardboard 'floor' with markings for the doors and windows. The model was divided into 16 zones marked in light pencil for scoring purposes. Landmarks were tables, chairs, shelves, cabinets, and a sink, a stove and a refrigerator. Test items were miniature representations of a street light, a tree, a toaster, an easel, a bookcase, a record player, and a stack of blocks.

Procedure - Each child was individually tested by the examiner with whom the children were familiar but never within the context of the nursery classroom. An advantage of this was to enhance the credibility of the examiner's questions about the classroom. A small room near the classroom and connected by a short hallway was used in testing. Inside the testing room the small-scale model of the school was oriented in space to correspond to the classroom. Children either identified the model or were told by the examiner. Testing did not continue until the child appeared to understand what the model stood for.

Each child was first asked to sort the test objects into those objects belonging to the school and those objects not belonging to the school, and to place those belonging inside the model "just like they stand in the big school room". A cover was then placed over the model and the child was asked to recall the objects he had placed. When the cover was removed, recognition was assessed.

The child was then instructed:

Tell me how you can know for sure if where you put the easel, the record player, and blocks, and the books are where they stand in your schoolroom? (Objects named for the experimenter included correct and incorrect objects given by the child but not omissions.) If the child did not say he could return to the classroom as the way to check, up to three prompts of increasing intensity were used to see when, if at all, the child would realize how he could verify his performance.

Prompt 1: What can you do to know for sure if you did it the right way?

Prompt 2: Where can you look to know for sure if you did it the right way?

Prompt 3: Would going into your classroom help you know if you did it the right way?

Children were instructed to return to the classroom to verify performance and to then return to the testing room. Verifying time was recorded, and memory for object locations was reassessed after the child returned to the testing room. Placement performance after verification was assessed starting with the objects standing as the child originally placed them before returning to the classroom.

Scoring - Children earned one point for each object correctly recalled and for each object correctly recognized, and object placement and object replacement responses were scored either 0, 1, or 2 points. Two points

were given for each object placed in the correct zone of the correct corner of the model, while one point was given for each object placed in the correct corner but not the correct zone. No credit was given for objects placed in the wrong corner of the school model.

Verification performance was scored using two measures of verification comprehension and one estimate of verifying behavior. Comprehension measures were a rating score for the child's answer to the initial verification inquiry (Rated on a six-point scale from self-centered to criterion-centered. See Table 2) and a score for the number of prompts needed by the child to realize how to verify (four minus the number of prompts needed). A time score in seconds was used in this study as an estimate of verification from the time the child entered the classroom.

Results

Memory Performance - In general, the children had little difficulty in sorting school objects from non-school objects, and in recognizing objects they had placed in the school model. The mean object sorting score was 6.42 out of 7 and the mean object recognition score was 3.7 out of a possible 4. Children had greater difficulty correctly placing school objects, and in recalling objects placed. The mean object placement score of spatial memory was 4.9 out of a possible 8 points, and the mean object recall score was 1.8 out of a possible 4 points. Children performed better in replacing the school objects after verifying first performance by inspecting the classroom. The mean object replacement score of spatial memory was 5.6 out of 8 points.

Verification Performance - Most children comprehended verification, but few realized how to verify spontaneously (Table 1). Thirty of 37 children understood verification after prompting, but only four children produced the correct strategy on the initial inquiry.

Childrens' responses to the initial verification inquiry, "How can you know for sure...", fell into six types (Table 2). The frequency of children falling into each response category were: 15 children said "I don't know" or gave no response, two children appealed to their feelings (e.g. "I like it this way," "that's how I want it"), 5 children appealed to their thoughts (e.g. "my head told me I did it right"), three children appealed to their immediate perception of the model (e.g. "I see it"), 8 children appealed to their memory of the school (e.g. "I just saw it when I came to school today"), and four children appealed to a verification plan (e.g. "You go inside the school and look at where the easel is and the blocks"). The responses were further classified as self-referenced, model-referenced, and criterion-referenced. Criterion-referenced responses of planning were scored higher than responses of memory because they reflect the appropriate verification strategy. However, the latter may represent a preference for using internal over external memory aids (c.f. Ritter et al, 1973).

Table 3 shows the correlations of object placement scores and object replacement scores with the verification measures with the effects due to age partialled out. Placement memory was correlated with spontaneous verification, prompts, and time at $r = .34(p < .05)$, $r = .18(p > .05)$, and $r = .08(p > .05)$, respectively, for a mean correlation of $r = .20(p > .05)$. On the other hand, replacement memory correlated positively and

significantly with spontaneous verification rating scores ($r = .46$, $p < .01$) and verifying time ($r = .37$, $p < .05$), and the correlation of replacement memory and prompts was almost significant ($r = .30$, $p < .05$), for a mean correlation of replacement to the verification measures equal to $.38$, $p < .05$. The correlational difference between place scores and replace scores to verifying time is statistically significant ($t = 2.86$, $p < .01$). Moreover, when placement scores are partialled out, the correlation of replacement scores to verification time increases from $r = .37$ ($p < .05$) to $r = .49$ ($p < .01$). With place scores partialled out, the correlation of replacement scores with spontaneous verification equalled $r = .33$ ($p < .05$) and the correlation of replacement scores to prompts equalled $.28$ ($p > .05$). Adjusting for the child's initial place performance on the spatial memory task, the child's scores for spontaneous verification and verifying time predicts how well the child remembers the location of objects in the classroom after verifying. These correlations provide evidence in support of the proposition that young children are capable of purposeful memory-related behaviors (c.f. Ritter et al, 1973).

Discussion

The memory verification results of this study suggest stages that fit a three step model of subject-object differentiation and the tendency toward objectification during early childhood. Although longitudinal study is needed, the present data suggest that at first the child does not accommodate to any external criterion to verify performance, but rather relies on egocentric states. Secondly, the child is able to refer to events outside himself to vouch for response accuracy--at

first referring only to events within the perceptual field and then finally to what is not present but symbolically re-presented. Development of verification ability then, may be characterized as progress in an ability to decenter sequentially so as to bridge greater temporal, spatial, or psychological distance between self and object.

The estimate of verifying behavior used in this study was a rather crude one: Time scores for the duration of looking behavior by the child when he returned to the classroom to check the accuracy of his performance on the model. The mean time score in this study was 6.3 seconds with S.D. = 5.8 seconds. It is interesting that some children who looked into the classroom for about one or two seconds before returning to the testing room had appeared to comprehend verification during questioning in the testing situation. Either these children did not need much time to verify, or did not want to use much time, or did not possess behavioral skills to effectively translate knowledge about verification into practice. Perhaps the ability to attend effectively to the criterion to compare with one's representation of performance is a later developing capacity than is the awareness of the utility of verifying. Future research using better indices of verifying behavior can explore these and other issues.

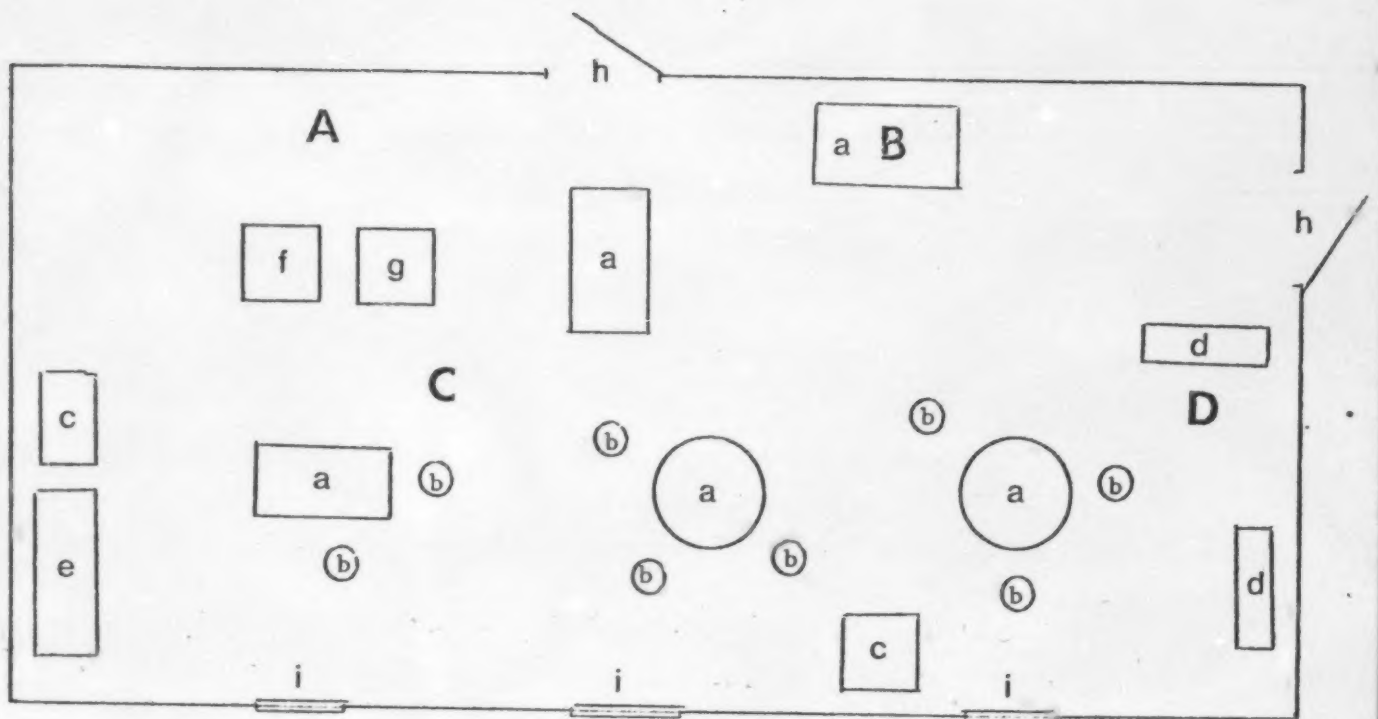
To summarize, the results of this study support two conclusions. First, the finding that memory after verification was significantly and positively associated with spontaneous verification comprehension and verifying time suggests purposeful cognitive behavior in preschool children. This is in accord with a growing body of research on metamemory

and metacognition in the development literature (c.f. Brown, 1975; Flavell and Wellman, 1977). Secondly, the three levels of responses to the initial verification inquiry unearthed in this exploratory study suggest a pattern consistent with well known developmental theories of tendencies toward objectification during early childhood (e.g. Werner, 1948).

The memory verification paradigm as introduced in this study involved meaningful and familiar task content reflecting actual space of the child's ecological environment. The approach of this study has potential not only as one way to study deliberate cognitive behaviors but also as a way to study children's verification ability per se and in relation to other cognitive abilities. The study demonstrates that preschool-aged children appear to be able to operate on a symbolic level using a symbolic representation of their environment, and furthermore, appear to comprehend the utility of using real world referents to confirm their representations. Asking children to remember and to verify their memory for features of their own life space, rather than to deal with artificial methods, appears to be an effective test of the child's capacity to cope on the symbolic plane, a procedure and assessment strategy that is recommended for additional use.

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KEY

Test Objects

- A** Blocks
- B** Record Player
- C** Easel
- D** Bookshelf

Landmark Objects

- a** Table
- b** Chair
- c** Cabinet
- d** Shelf
- e** Sink
- f** Toy refrigerator
- g** Toy stove
- h** Doorway
- i** Window

Figure 1

Representation of Small-Scale Model of Classroom

Table 1
 Number of Children Understanding the Memory Verification Strategy
 Upon Initial Inquiry and on Subsequent Prompt Levels

N	Level of Questioning	Wording of Prompt
4	Initial Inquiry	"How can you know for sure if you did it the right way?"
9	Prompt 1	"What can you do to know for sure if you did it the right way?"
8	Prompt 2	"Where can you look to know for sure if you did it the right way?"
9	Prompt 3	"Would going to your classroom help you know for sure if you did it the right way?"
7	Failure Instructions	"Go to your classroom to know for sure if you did it the right way."

Table 2

Distribution of Responses to Initial Request for Verification

N	Score	Type of Response	Response Category	Example of Response
5	0	No response; "I do not know"		
2	1	Appeals to Feelings	Self-referenced	"I like it this way"; "I want it like this"
5	2	Appeals to Thoughts	Self-referenced	"My mind told me I did it right"; "I think it in my mind."
3	3	Appeals to Perceptions	Model-referenced	"I see it right here"; "Look (here) & see"
8	4	Appeals to Memories	Criterion-referenced	"I saw it when I came to school today"; "I remember my school like this".
4	5	Appeals to Strategies	Criterion-referenced	"You go and peak inside to see if everything is all right"; "You go out and see the big school".

Table 3
Zero Order and Partial Pearson Product-Moment Correlations
Among Memory Scores and Memory Verification Scores and
Age for Total Sample (N=37)

	1.	2.	3.	4.	5.	6.	7.
1. Place		.25	.26	.34*	.18	.08	.77*** ¹
2. Recall	.40*		.20 ¹	.31	.34*	-.03	.26
3. Recognize	.41*	.50** ¹		-.05	.14	.03	.21
4. Spontaneous	.36*	.31	.03		.32* ²	.28	.46**
5. Prompts	.28	.46**	.31	.33* ²		.28	.30
6. Time	.17	.13	.18	.30	.35*		.37*
7. Replacement	.80*** ¹	.46**	.44**	.46**	.41*	.44**	
8. Age	.36*	.60***	.62***	.11	.33*	.26	.43**

Note. Zero-order correlations are below the diagonal; correlations with effects of age partialled out are above the diagonal.

* $p < .05$

** $p < .01$ two-tailed test

*** $p < .001$

1. Not independent measures

2. Not entirely independent measures; children obtaining highest rating for spontaneous verification response obtained highest score on prompts index.

Table 4
 Correlations of Placement and Replacement Scores
 with Verification Measures with Age Partialled Out

Verification Measures	Placement	Memory Score	Replacement	t
Spontaneous	.34*		.46**	1.16
Prompts	.18		.30	1.18
Time	.08		.37*	2.86**

* $p < .05$
 ** $p < .01$ two-tailed test